



# Terra-Kleen Extraction Technology

## *An Innovative Method for Treating PCBs in Soil*

NELP Fact Sheet No. 2

*Success Stories*

January 1995

### ABSTRACT

This is the second in a series of fact sheets that shares information on successful technologies and strategies applied at Naval Air Station (NAS) North Island through the Navy Environmental Leadership Program (NELP). This fact sheet provides information on an innovative and cost-effective polychlorinated biphenyl (PCB) extraction technology successfully demonstrated at NAS North Island. The intent is for other Naval installations to consider this and other tested technologies and strategies for cleanup, compliance, pollution prevention (P2), and conservation efforts.

### BACKGROUND

On October 23, 1993, the Secretary of the Navy approved the NELP for implementation at NAS North Island and NS Mayport in Florida. NELP was established as a Navy initiative to focus on finding new and innovative ways to manage environmental programs at Navy bases. Under NELP, NAS North Island is identifying and demonstrating innovative cleanup, compliance, P2, and conservation technologies at reduced costs that will have broad application Navy-wide.

A PCB extraction technology was evaluated at NAS North Island under NELP in association with the U.S. Environmental Protection Agency (EPA)

Superfund Innovative Technology Evaluation (SITE) program. This evaluation provided an opportunity for effective teaming with other environmental programs, an essential element of the NELP initiative.



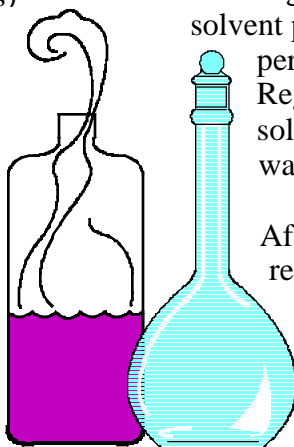
The primary objective of the evaluation was to determine the effectiveness of the technology in removing PCBs from soil. The removal of PCBs from soil has traditionally been difficult and costly. The PCB extraction system developed by the Terra-Kleen Response Group, Inc. is an attempt to overcome many of the soil handling, contaminant removal, and regulatory restrictions that have made implementing a cost-effective PCB soil treatment system difficult.

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## TECHNOLOGY DESCRIPTION

The Terra-Kleen solvent extraction (Terra-Kleen) technology was developed for on-site removal of semivolatile organic compounds (SVOCs) and nonvolatile organic materials from soil. The Terra-Kleen technology is a batch process system that uses a proprietary solvent to separate organic contaminants from soils. The treatment system also employs a solvent regeneration system that concentrates the extracted contaminants and allows reuse of the extraction solvent. Following on-site treatment, the soil can be returned to the land while the concentrated contaminant



purification unit. The microfiltration unit removes any fine particles remaining in the solvent. The solvent purification unit separates organic contaminants from the solvent and concentrates them, reducing the volume of hazardous waste. The spent solvent purification media are either disposed of at a permitted disposal facility or are regenerated. Regenerated solvent is pumped into the clean solvent storage tank for use in subsequent wash cycles.

After treatment is complete, residual solvent is removed from the soil using a vapor extraction unit. Solvent vapor and air are drawn through the treated soil in the tank, and passed through a condenser and liquid filter. Although a biological treatment process was not demonstrated in the pilot-

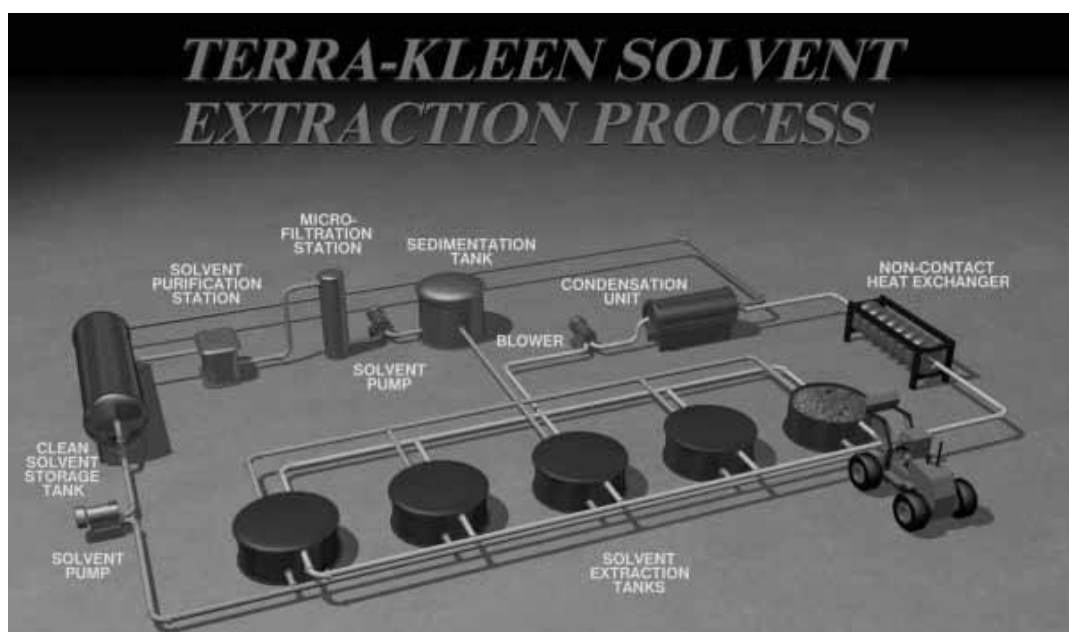
scale demonstration, the soil can be further treated using a biological treatment process. Figure 1 shows the schematic for the Terra-Kleen extraction system demonstrated at NAS North Island.

The treatment process includes placing the contaminated soil into an extraction tank which is then filled with Terra-Kleen's proprietary solvent, which solubilizes the PCBs. Next, the solvent is drained and transferred into a sedimentation tank where residual soil is separated from the solvent. The spent solvent is then purified by removing PCBs and other organic materials using a solvent regeneration process.

The solvent regeneration process includes a microfiltration unit and the proprietary solvent

Two residual waste streams are generated with this technology. They are the PCB concentrates from the solvent purification process, and the solvent vapor generated during the vapor extraction process. The waste streams are deposited in the solvent purification station.

Figure 1





## OPERATIONAL SUPPORT REQUIREMENTS

The Terra-Kleen technology consists of several major components: the solvent extraction unit, the sedimentation tank, the solvent purification unit, and the vapor extraction unit. On-site assembly and maintenance requirements are minimal. Once on site, the treatment system can be operational within 2 days if all necessary equipment and utilities are available. Earth-moving equipment is needed to move soil to and from the treatment area. Fluid pumping systems are driven pneumatically by a compressor. The vapor extraction pumps are powered by an electric, 3-phase, 220-volt system. If biological treatment was used, a water supply would be required to mix the biological slurries for solvent residual consumption by the microbes.

Siting requirements for the Terra-Kleen system range from 300 square feet for a small-scale, single extraction vessel configuration (treating 1 ton of soil per day) to 40,000-square feet for larger operations (up to 25 tons per day). Access roads are needed for equipment transport. An area designed for spill containment is required to accommodate the wash unit. This could be as simple as placing plastic sheeting on the ground surrounded by a berm made from hay bales.

After treatment is completed, the system can be demobilized and moved off site within 2 days.

In addition to equipment and utility requirements, some regulatory requirements must also be addressed to operate Terra-Kleen. An application for a Toxic Substances Control Act (TSCA) operating permit is under EPA review. The TSCA permit will replace the need for an operating permit and allow operation at any location in California. However, operation of the unit must also comply with air regulations and surface water discharge requirements. The air regulations will vary with location, depending on the air quality of the surrounding county. Typically, a discharge permit is needed to discharge any wastewater to a municipal treatment plant.



## DEMONSTRATION RESULTS

The pilot-scale demonstration took place at NAS North Island, Site 4, in June 1994. Terra-Kleen conducted 11 wash cycles in 7 days to simultaneously treat five 1-ton soil batches. The wash cycles were discontinued when PCB concentrations in the five extraction tanks were reported at 1.54 to 1.85 mg/kg by on-site gas chromatography (GC). The loading capacity was not determined during the demonstration due to the high capacity of the solvent purification unit; full capacity was not required. Table 1 shows the results of the soil treatment demonstration.

Table 1. Results from the pilot-scale demonstration

Parameter	Tank A	Tank B	Tank C	Tank D	Tank E
PCBs in untreated soil (mg/kg)	130	140	134	147	170
PCBs in treated soil (mg/kg)	1.70	1.54	1.69	1.77	1.85
Percent removal (percent)	98.7	98.9	98.7	98.8	98.9

## TECHNOLOGY LIMITATIONS

No treatment system is universally applicable. There are some conditions that would decrease the effectiveness of treatment, and they include:

- Soil containing more than 20 percent clays or fines where contaminants are strongly sorbed
- Soil with high moisture content where solvent dilution occurs (this condition may require an additional distillation step in the treatment process to maintain solvent purity)
- Metal contamination because it cannot be treated
- Cold climates where a temperature-controlled warehouse would need to be constructed to house the treatment system

## TREATMENT COST

The initial estimated cost to treat 1 ton of soil is between \$165 and \$600. This cost can be expected to vary depending on contamination type (other than PCBs), concentration, and total volume of soil treated. A cost comparison to traditional PCB treatment and disposal options is presented in Table 2. Compared to the treatment costs for PCBs using incineration, the Terra-Kleen technology presents an effective alternative PCB treatment, that is comparable to landfill disposal costs.

## BENEFITS TO THE NAVY

The Terra-Kleen solvent extraction system is an innovative technology effective for reducing PCB concentrations in soil. The demonstration showed the following advantages of this technology:



- Cost-effective alternative for PCB treatment, compared to traditional PCB incineration treatment.
- Comparable cost to land filling without future legal liability
- Easily mobilized
- Versatile, can treat a variety of SVOCs and other organic compounds that may be present in the soil
- Requires minimal site preparation to stage the treatment system
- Terra-Kleen has applied for a TSCA operating permit with EPA. Upon approval of the TSCA operating permit, Terra-Kleen can operate this technology at any location in California. No additional operating permit is required.

Table 2. Cost Comparison For The Terra-Kleen Extraction System

	Landfill Disposal	Incineration	Terra-Kleen Extraction
Costs per ton of soil treated	\$200 to \$300 <sup>1,3</sup>	\$2,000 to \$4,000 <sup>1,3</sup>	\$165 to \$600 <sup>1,2,3</sup>

<sup>1</sup> Cost per ton treated were obtained from EPA SITE technology capsule.

<sup>2</sup> Total includes capital costs, mobilization costs, operation and maintenance, and demobilization costs.

<sup>3</sup> Does not include transporter costs.

## SOURCES OF ADDITIONAL INFORMATION:

Additional technical information can be obtained from the EPA SITE Demonstration Bulletin (EPA/540/MR-94/521) and Technology Capsule (reference number not yet available). Copies of these publications can be obtained from:

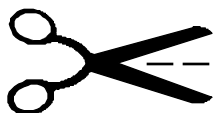
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If you would like to be included or change your address on the mailing list for the NELP fact sheets; please fill out, detach, and fax or mail this form to NAS North Island at the address below.

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